Load carriage

Female officers carry their share

Orr, Rob Marc

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Load Carriage: Female Officers Carry Their Share

Dr Rob Orr (PhD, PHTY, BFET, TSAC-F, ADFPTS)

2017 International
Women & Law Enforcement
CONFERENCE
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HISTORICAL CONTEXT - POLICING

http://2.bp.blogspot.com/-xHtSiLRFIMQ/UfewLRnEgAI/AAAAAAAAIpc/54yapn_ibtE/s1600/Curious+Black+&+White+Photographs+of+The+Police+Officers+from+1890–1930+(28).jpg

http://3.bp.blogspot.com/-HO26ffMhqS4/UiHkEhycroI/AAAAAAAAMR4/qGsg2ryfWKA/s640/Pictures+of+Life+of+the+New+York+Police+Department+in+the+1970's+(7).jpg

http://images.smh.com.au/2012/12/04/3861588/art-police-uniforms-620x349.jpg

http://images.smh.com.au/2009/03/09/410908/policebelt.jpg

http://www.gunblast.com/images/WBell_PoliceHolsterHist/Police-Holster-History-012.jpg

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HISTORICAL CONTEXT - POLICING

- Police are becoming Christmas trees

http://img.dailymail.co.uk/i/pix/2008/04_03/TabGunGirlLEWIS_468x715.jpg

http://images.canberratimes.com.au/2012/06/24/3406673/art-29-st24policewomen-420x0.jpg

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HISTORICAL CONTEXT - POLICING

- Increasing levels of threat

NSW TOU Mean Load of 22kg

Excluding specialised equipment

Photograph taken by author

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AUSTRALIAN CONTEXT

ILAV type (A-C) & Normal station wear (N)	ILAV Weight (kg)	Duty load Complete (kg)	Total load including officer weight (kg)
A	4.12 ± 0.65*	11.53 ± 0.77‡	88.03 ± 20.49
B	3.54 ± 0.70*	11.01 ± 1.01‡	87.51 ± 20.60
C	3.24 ± 0.48*	10.77 ± 1.16‡	87.27 ± 20.66
N	NA	8.69 ± 0.68	85.19 ± 20.24

* Significantly different ($p<0.05$) between vests:
‡ Significantly different ($p<0.001$) from normal station wear

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AUSTRALIAN CONTEXT

	FEMALE	MALE	FEMALE	MALE
ILAV type	**ILAV + Duty Loads (kg)**	**ILAV + Duty Loads (kg)**	**%BW**	**%BW**
A	11.14	11.85	16.90	14.90
B	10.80	11.18	16.43	13.91
C	10.24	11.22	15.60	13.95
N	8.68	8.70	13.20	10.92
	*p=0.225		*p=0.009	

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US CONTEXT

Dulla et al (2017).

	COMBINED (n=246)
Age (yrs)	30.82±5.84
Years sworn (yrs)	3.62±3.46
Body Wt (Kg)	85.69±15.08
Load Wt (Kg)	10.72±1.73
Relative load (%)	11.83±2.38

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US CONTEXT

Dulla et al (2017).

	FEMALE (n=43)	MALE (n=203)
Age (yrs)	30.60±4.56	30.86±6.09
Years sworn (yrs)	4.03±2.92	3.54±3.56
Body Wt (Kg)	68.78±10.96*	89.27±13.31
Load Wt (Kg)	9.99±1.66*	10.87±1.71
Relative load (%)	13.36±2.46*	11.50±2.24

* Significantly different from male sheriffs, p<.001

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ABSOLUTE VS RELATIVE LOADS

- Both LEO studies found female officers carried either the same (AUST) or lighter (US) absolute loads compared to the male officers
- However when expressed as a percentage of their body weight female officers carried significantly more relative load than male officers

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ABSOLUTE VS RELATIVE LOADS

- Currently female soldiers carry lighter absolute loads than male soldiers but only slightly heavier relative loads

Orr et al (2015).

*ABSOLUTE LOADS**	*RELATIVE LOADS*
FEMALE: *M* = 26.4 kg	FEMALE: *M* = 43%
MALE: *M* = 39.0 kg	MALE: *M* = 47%
p=.045	**p=.55**

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ABSOLUTE VS RELATIVE LOADS

- Currently lighter soldiers carry the same absolute loads as heavier soldiers but heavier relative loads

Orr et al (2015).

ABSOLUTE LOADS	*RELATIVE LOADS*
Light 20%: *M* = 34.7 kg	Light 20%: *M* = 49%
Heavy 20%: *M* = 35.7 kg	Heavy 20%: *M* = 36%
p=.902	**p=.0509**

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ABSOLUTE VS RELATIVE LOADS

- Both Lyons, et al. (2005) and Ricciardi, et al. (2007) observed a reduced aerobic capacity and load carriage task performance ability (p=.01) in participants with increased levels of body fat.
- Even when participants were wearing a *relatively* light load (10 kg body armour), the amount of body fat of males (17%) and females (26%) was found to negatively correlate (*r*=-0.88; p<.001) with physical task performance (Ricciardi, et al., 2007).

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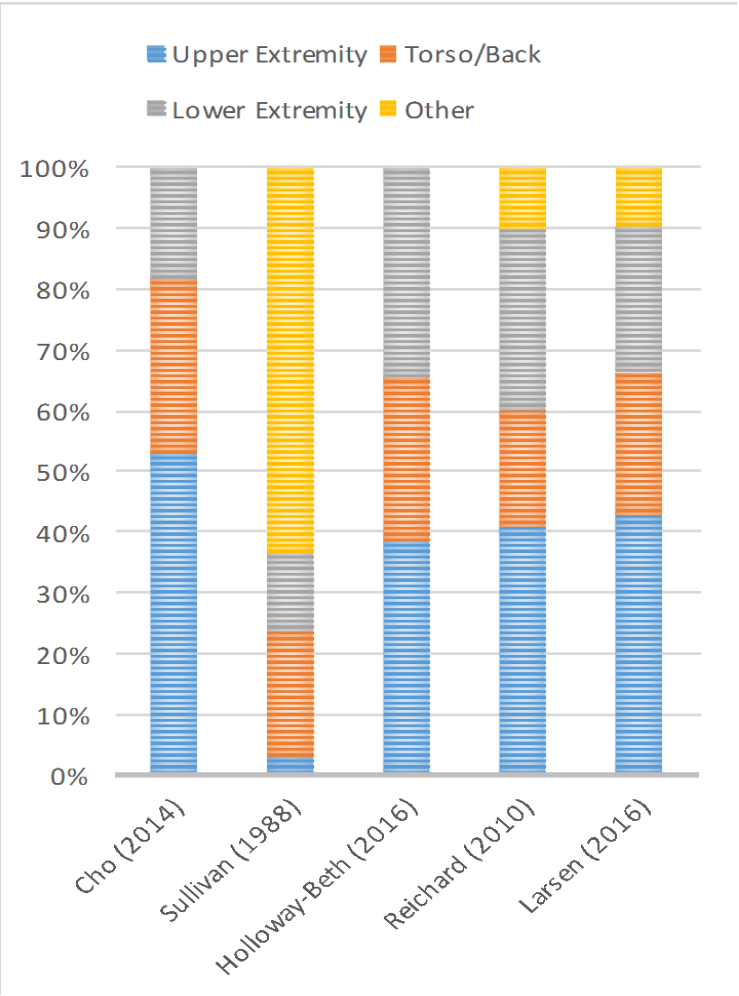
INJURIES IN POLICING

Lyons et al (2017).



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SEX DIFFERENCES IN LC INJURIES

Orr et al (2016).

- Mean ARA population over 2 years = 24,876 personnel
  - Female *n*= 2441 (10%): Male *n*= 22435 (90%)

- 401 reported injuries associated with load carriage
  - Female *n*=40 (10%): male *n*= 361 (90%)
  - RR = 1.02 (95% CI 0.74 to 1.41)

- SPI
  - Female *n*=6 (15%): male *n*= 23 (6%)
  - RR of SPI = 2.40 (95% CI 0.98 to 5.88)

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SEX DIFFERENCES IN GENERAL INJURY RX

Orr et al (2015).

Primary Injury	N	% of Injuries	Total Treatments Attended	Mean ±SD Treatments/ Patient
Neck				
Male	4	13.3	13	3.25 ± 0.5
Female	2	16.7	5	2.5 ± 0.71
Total	**6**	**14.3**	**18**	**3.0 ± 0.63**
Lumbar Spine				
Male	13	43.3	85	6.54 ± 3.73
Female	4	33.3	34	8.5 ± 3.7
Total	**17**	**40.5**	**119**	**7.0 ± 3.71**
Shoulder				
Male	5	16.7	40	8.0 ± 5.43
Female	2	16.7	29	14.5 ± 6.36
Total	**7**	**16.7**	**69**	**9.86 ± 6.04**

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SEX DIFFERENCES IN LC INJURIES

- The most common site of injury for both sexes was the back (F: 27%; M: 22%).

Orr et al (2016).

- Female Soldiers:
  - the foot (20%),
  - ‘neck and shoulder’ and knee (12%) and
  - ankle (10%).
- Male Soldiers:
  - the ankle (17%),
  - knee (11%),
  - ‘neck and shoulder’ (10%) and
  - foot (9%).

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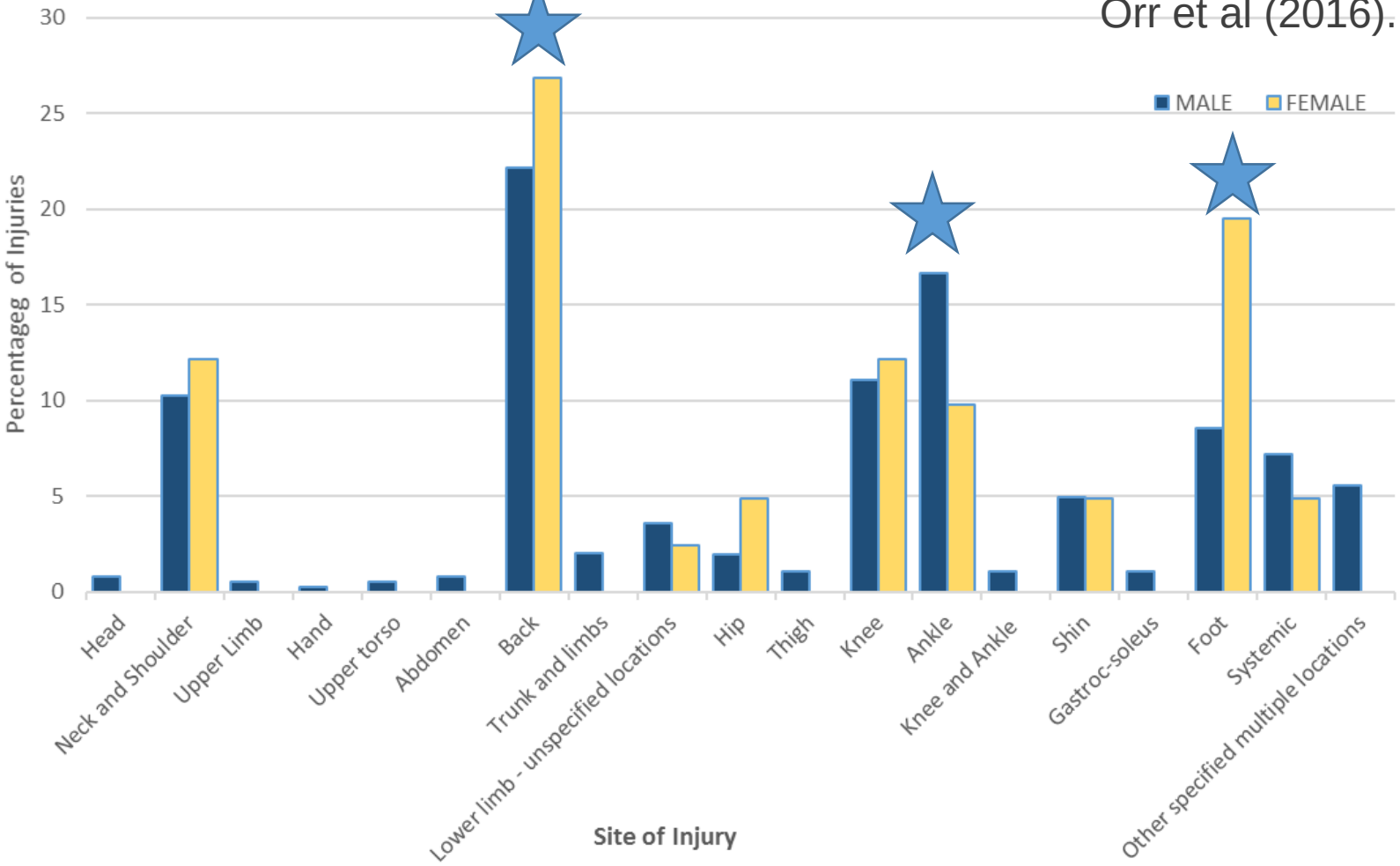
Orr et al (2016).



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INJURIES DUE TO LOAD CARRIAGE

Mechanism of Load Carriage Injuries	**Number of reported injuries (%)**	
Muscular stress	251	62%
Fall	85	21%
Exposure to environmental heat	28	7%
Rubbing and chafing	21	5%
Stepping kneeling or sitting on objects	9	2%
Unspecified mechanisms of injury	3	1%
Contact with moving or stationary object	4	1%
Other and multiple mechanisms of injury	2	0%
Being trapped between stationary and moving object	1	0%
TOTAL	***404***	***100%***

Orr et al (2015).

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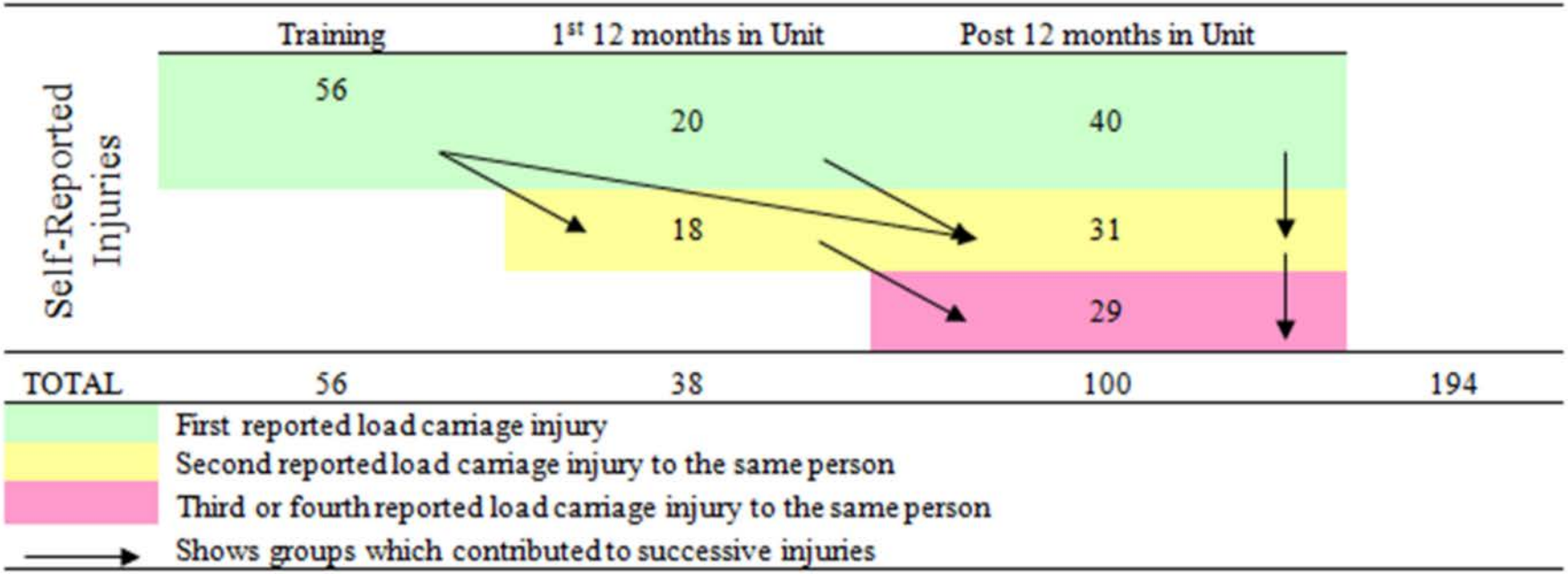
INJURIES DUE TO LOAD CARRIAGE

Orr et al (2017).



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IMPACTS ON PERFORMANCE

- ↑ in load weight = ↑ in the energy cost of standing, walking (forwards and backwards, up and down stairs) and running

http://cdn.abclocal.go.com/content/kabc/images/cms/automation/vod/1167564_1280x720.jpg

http://resources3.news.com.au/images/2012/09/10/1226471/157347-pn-police-arrest.jpg

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IMPACTS ON PERFORMANCE

- ↑ in speed of load carriage = ↑ in the energy cost of carrying given load (more than weight)?
  ↑ *0.5km/h= ↑10kg*

Photograph taken by author

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IMPACTS ON PERFORMANCE

- ↑ in gradient of load carriage = ↑ in the energy cost of carrying given load (more than weight)?
  ↑ *1%= ↑10kg*

https://i.pinimg.com/736x/79/72/dc/7972dccc21cb2acd712fcf4a123c788f--police-family-police-life.jpg

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IMPACTS ON PERFORMANCE

- Different terrains types will elicit different energy cost requirements

  (road-light brush-heavy brush-sand)

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IMPACTS ON PERFORMANCE

- Differences in load placement will elicit differences in energy cost.
  - Weight on the feet more costly than the back
  - Thigh more costly that back (0.5kg increases cost by 3.5%)
  - Waist less costly than back (use of waist belts on packs)
  - Shoulder more costly than back

http://images.smh.com.au/2012/12/04/3861588/art-police-uniforms-620x349.jpg

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IMPACTS ON PERFORMANCE

- Decrements in performance:
  - ↓ **Mobility**
    - Impeded mission success (Breen 2000)

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IMPACTS ON PERFORMANCE

- Decrements in performance:
  - ↓ Marksmanship (Knapik et al., 1990:1991:1997: Rice et al., 1999).
  - ^{0}Change Marksmanship (Orr et al., 2014).

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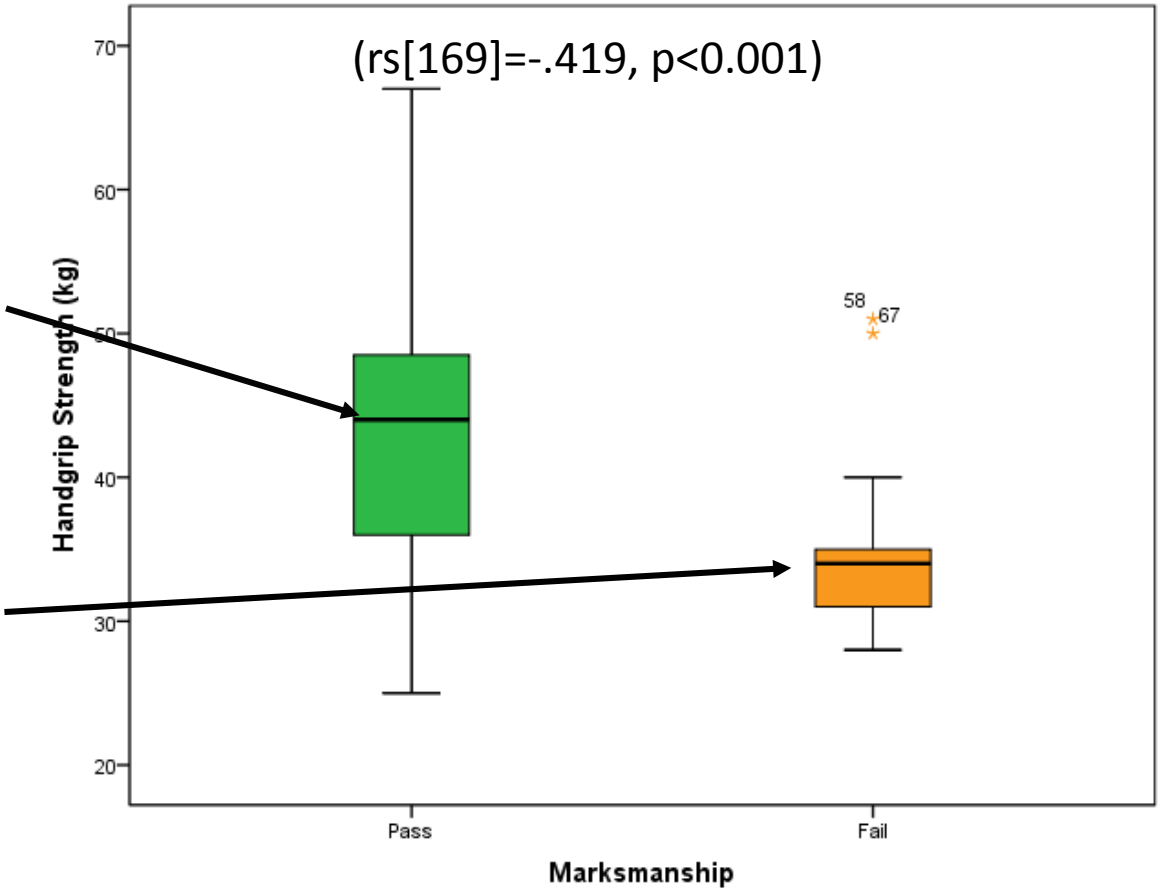
IMPACTS ON PERFORMANCE

Orr et al (2015 & 2017).

- **Grip Strength and Marksmanship**

43.22 ± 8.04 kg
(25-67)

34.67± 5.94kg
(28-51)



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IMPACTS ON PERFORMANCE

- Alertness: Attention to task: Response to stimuli
  (Johnson et al., 1995: May et al., 2009: Mahoney et al., 2007)

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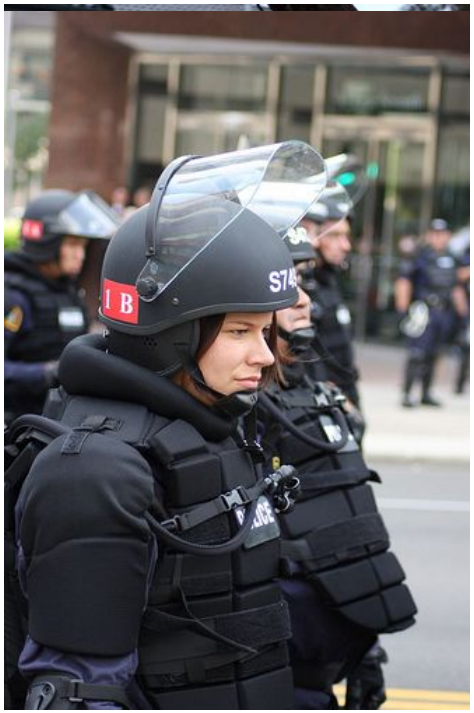
RISK MITIGATION

- Change the job
- Change the equipment
- Change their fitness
  - Increase aerobic fitness and upper body strength
  - Minimise fat mass and increase lean mass

  → Other downstream benefits



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CVD STRESS

- Police officers are twice as likely to develop cardiovascular disease when compared to the general population (Ramey, et al., 2014)
- Poor lifestyle choices
  - e.g. nutritional intake

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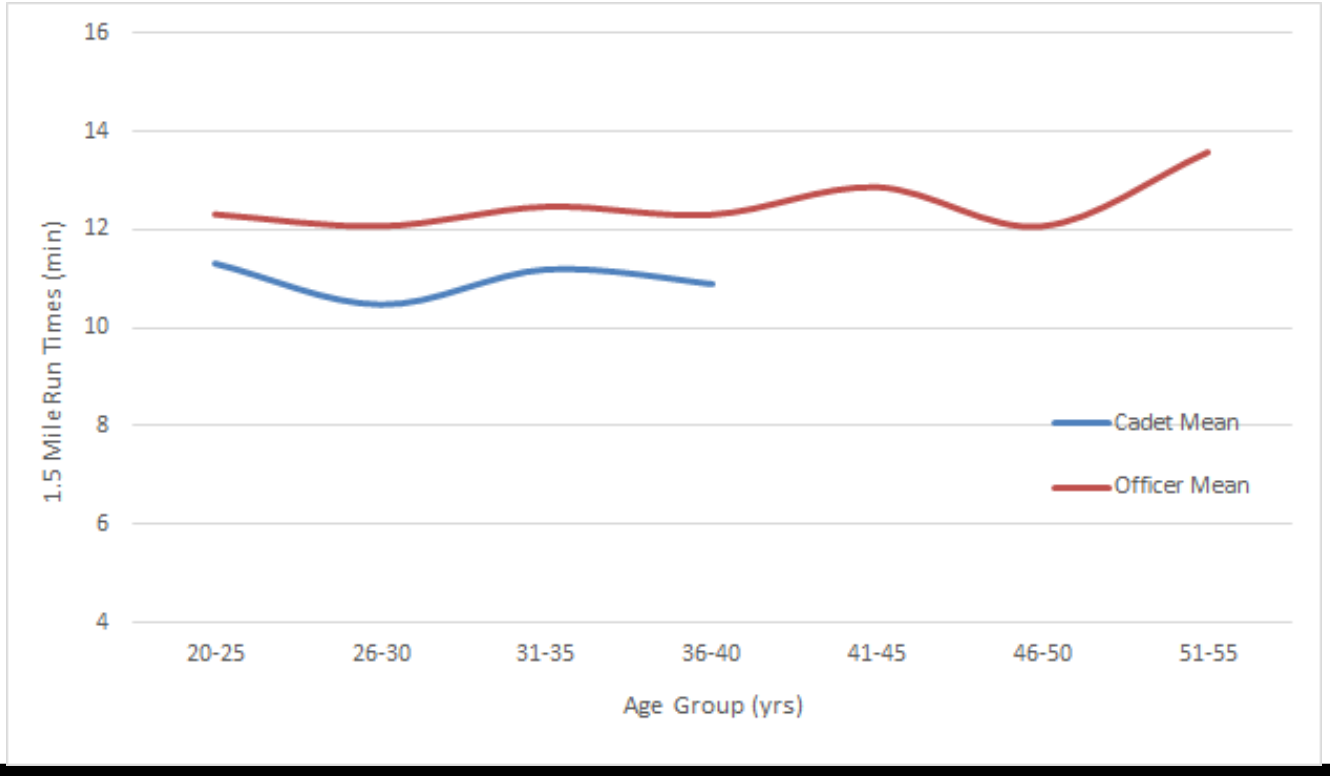
CVD STRESS

Orr et al (2017).

- Police officers are less fit than recruits for same age?



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CVD STRESS

Decker et al (2016).

- a 40-year-old male officer who breached his predicted maximum HR during three separate calls within one day,
- two officers' HR ranging from 188 to 209 b.p.m. on four separate occasions, and
- four officers (one call out) 'driving urgently' to a 'domestic incident', who all recorded concerning HR, ranging from 185 to 198 b.p.m

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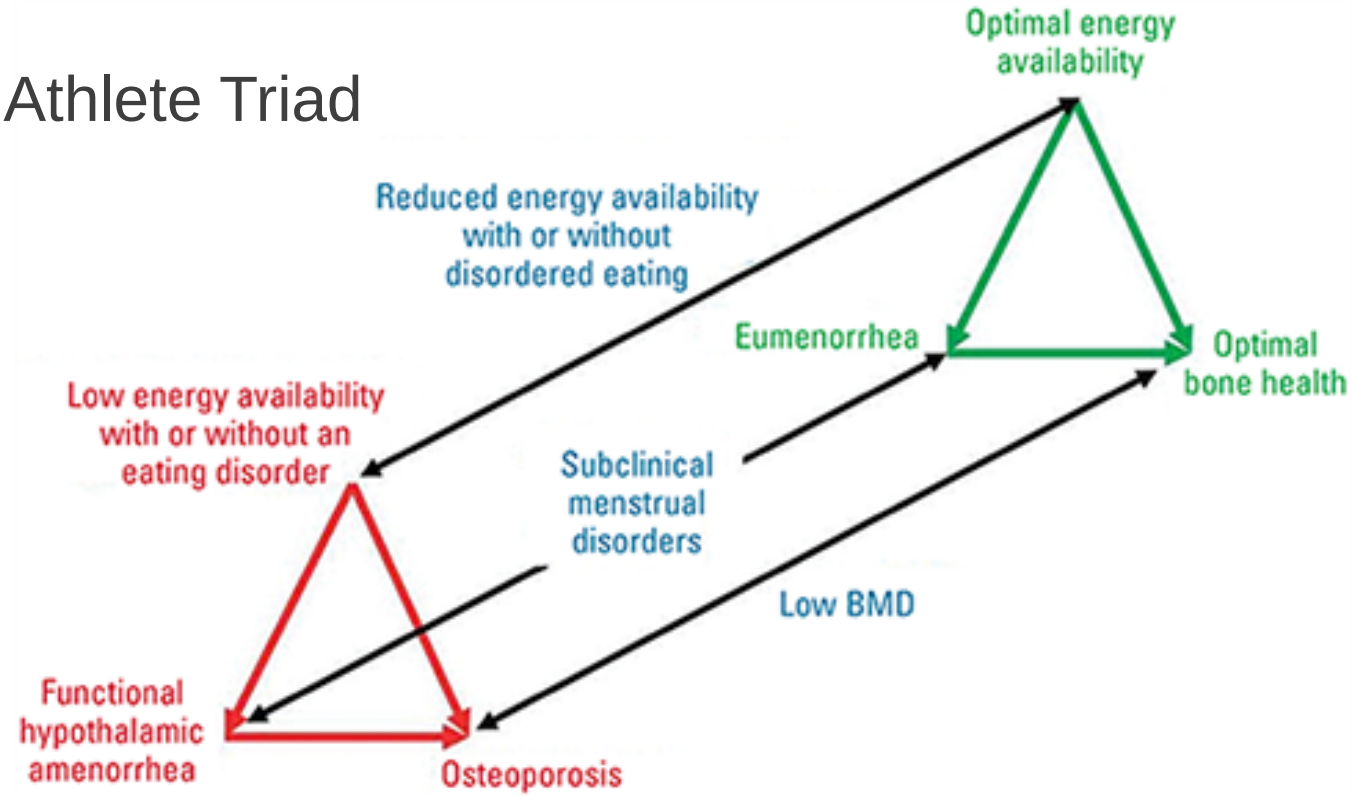
RISK MITIGATION

- The Female Athlete Triad



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RISK MITIGATION

- In a study by Rauh et al., (2006) female soldiers who reported being amenorrheaic were found to have an almost threefold increase in lower-extremity stress fracture risk (amenorrhoea prevalence rate of around 45% has been found for female military recruits (Cline, 1998)) .

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RISK MITIGATION

- Low energy intake
  - Increased energy cost of load carriage
  - Body image and limiting dietary intake
  - Shift work (Hinton, et al., 2017)
- Even if caloric intake is high through poor meal choices there are concerns:
  - female soldiers may not be meeting their recommended daily iron intake requirements (Booth, 2002)

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RISK MITIGATION

- Poor nutrition + Amenorrhea = negative impact on bone health
- Poor nutrition

  = increased fatigue when working → poorer movement mechanics → increased load on passive system (bones).

  = poorer recovery from previous day's efforts.

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RISK MITIGATION

- PFM Dysfunction
  - 25-31% of female soldiers have reported PFMD (Davis et al., 1999)
    - Lead them to drink less fluids
    - Contributes to spine stability
  - Post partum PFM retraining vital

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SUMMARY

- Female officers will be required to carry loads that, in general, will be relatively heavier than that of male officers
- Female officers need to be conditioned to carry these loads
- A holistic supported implementation plan is needed to mitigate the impact of occupational load carriage in LEO

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To all serving LEO (past and present)
Thank you for your service

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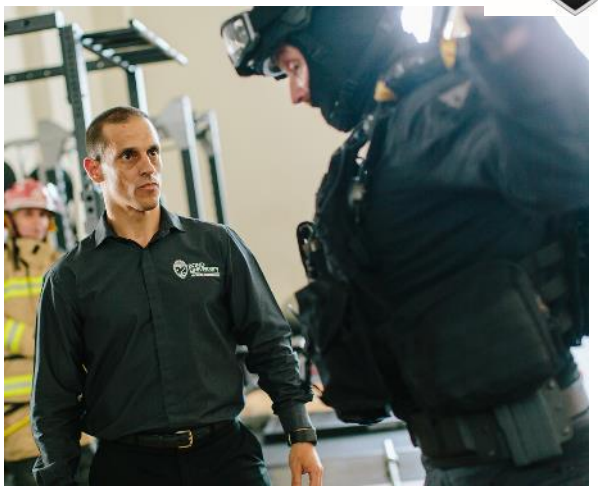

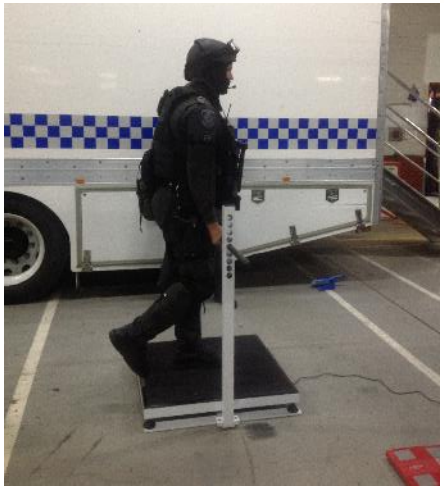

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References available on request:

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